A Meta-design Approach to Interactive Spaces

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ABSTRACT
Interactive spaces provide new affordance, allowing real-time interaction between users and digital/physical space, the possibilities of multimodal, whole body interaction and working with new design methods or input devices. The challenge is however that interactive spaces are not easily modifiable for different purposes. As every interactive space is a unique place, software must be adapted to the available components. In this paper, we present a preliminary exploration in interactive space that demonstrates how the integration of an interactive wall and adaptable software can be used to facilitate collaborative design. The contribution of this paper is to augment interactive spaces via a meta-design approach.

Categories and Subject Descriptors

General Terms

Keywords
Interactive Wall, interactive spaces, Creativity Barometer, MikiWiki, meta-design, visualization, co-located collaborative design

1. INTRODUCTION
We consider interactive space as a place where interactive surfaces, smart devices and specific kinds of software can be combined to support collaborative design. The resulting socio-technical settings can be an incubator for creativity but only if the hardware components are well aligned with the employed software and the communication structure within the design team. To achieve this alignment software is needed which pursues the principles of meta-design [1, 2] to establish a socio-technical environment which includes the tools and methods to adapt itself to the needs of its "inhabitants." This paper describes a test case with which an interactive space can be evaluated with respect to creativity support and the features of appropriate meta-design software. The combination of both helps to demonstrate the benefits and limitations of supporting collaborative creativity with an interactive space.

2. TEST CASE
The IMTM-group has developed a micro-survey instrument – the Creativity Barometer [3] – which can be used in companies to continuously evaluate the creativity climate. Questions as displayed in Figure 1 can be continuously shown to the employees with a web browser to offer them an opportunity to give feedback how they perceive their company’s creativity culture. This should happen as an passant as possible. The Creativity Barometer allows companies and their personnel to periodically repeat surveys, to get an immediate feedback, and to comprehend changes in the creativity climate. It can also provide a good opportunity for employees to reflect on the development of their own attitude and comprehend how their colleagues perceive the creativity climate. After a pre-specified time period (e.g. eight months), the company can summarize the feedback and plan interventions to improve the creativity climate.

Within the last 5 days my colleagues encouraged me to develop new ideas
Agree

Figure 1 Creativity Barometer desktop interface

The Creativity Barometer was tested in four companies over several months, (for example, 99 employees produced 2673 answers in September 2011). To make it easier to give answers in between, it seemed to be reasonable to adapt the barometer interface for smart devices, and – since it was about creativity – to improve the interface in a way which conveys a stimulating experience. This design task itself requires creativity and we assumed that this is a test case where the interplay between a design-software environment, such as MikiWiki [4], and an interactive space with a large screen can be tested. The members of the research group, in which two programmers have developed the Creativity Barometer, run an experiment by...
themselves. Therefore, 25 experienced users of the web browser version were available to be designers of the new, mobile interface. These users had various backgrounds – some of them have never been software developers. In every design session the participants were asked to complete three phases: brainstorming, collaborative sketching, and drafting mock-ups.

3. MODLAB- AN INTERACTIVE SPACE

The modlab of the group for Information and Technology Management (IMTM) at the University of Bochum was developed for researching computer-supported collaboration in co-located meetings. The centerpiece is a large, high-resolution interactive wall (4.80m x 1.20m; 4320x1050 pixels), which seamlessly integrates three rear projection boards. Data can be entered and manipulated directly on the screen or via iPads, which are connected via WLAN [5]. Most important, the developing content of the large screen can be completely recorded as well as the participants’ activities with three cameras. Figure 2 shows the environment setting. A table is used for users to sit and get an overview of the design stage.

![Figure 2 Environment setting](image)

The recordings support a systematical analysis for understanding the dynamics of a meeting and for improving the tools and the whole socio-technical setting afterwards. The PC that is connected to the large screen can be used with every kind of Windows software or web browser. However, it turned out that many applications are not really feasible to be interactively used with a large screen. Since the modlab was dedicated to do research on collaborative modeling of business processes, a process modeling editor (SeeMe [6]) was modified to specifically meet the needs that emerge when using the interactive wall: context-sensitive smart-buttons, gesture-based interaction, digital ink etc. However, the process modeling support was mainly focused on the role of a facilitator who interacts with the wall to document and mirror the contributions of the participants of a meeting. These participants make their contributions either by telling the facilitator what they want to see on the display or by entering text via notebooks or iPads. Consequently, they do not use the interactive wall directly. This was caused by the dominance of the facilitator but also by the type of software that supports a linear design approach for a complex structure such as a business process model. A more associative design approach – where a facilitator only gives impulses but does not document the outcome, and where the participants become active by themselves to visualize their ideas – needs a specific type of software, such as the MikiWiki design environment. While well-prepared facilitation of co-located meetings for process modeling can include between 3 to 12 participants, a collaborative design of an interface where every participant has a chance to be active for the most time is limited to small numbers, ideally from two to four. Within these small groups the structuring of communication by a facilitator is not a permanent necessity. [In01] to [In13] are used in the text to identify the 13 interviews.

4. MIKIWIKI

The software we chose to conduct our test is MikiWiki, since as a meta-design environment it can be adapted to suit different interactive spaces and to cope with emergent socio-technical issues in an ongoing manner.

MikiWiki is a structured programmable wiki. For the purpose of this paper, we only briefly introduce one distinctive feature of MikiWiki, “nuggets.” In analogy with Lego construction kits, providing simple parts with which the user can create complex artifacts [7], nuggets are the building blocks of MikiWiki shared between stakeholders. Nuggets, as the basic components of MikiWiki, are independent from each other and can be used to create new tools or services.

A typical nugget consists of three pages: a data page in JSON format, a format page written in JavaScript defining how to render the data and a content page displaying the final visualized data (Figure 3). MikiWiki addresses a more fluid and bottom-up approach that empowers users to define and compose situated solutions. The way we designed nuggets aims to enable meta-design in use time, as each aspect of a nugget as a wiki page can be accessed, tailored and socially evolved over time, rather than remain predefined and unchangeable.

![Figure 3 Drawing nugget](image)

Users can use, mix and modify nuggets, introducing different behaviors or creating new ones. Figure 4 demonstrates participants designing a mobile interface with various nuggets, e.g. PostIt note, different toolbox, canvas and trash nuggets, etc. Participants can utilize the sync-imagename nugget to create moodboards, or the drawing nugget to visualize some abstract concepts. This not only helps them to express emotional attitudes but also to understand their expectations towards the system.
5. FINDINGS

5.1 Adapting MikiWiki for the Interactive Wall

The design environment for the Creativity Barometer was intended to be a set of moveable panels to support direct manipulation and to fully exploit the large interactive wall. Users were able to drag, drop and resize design elements, rearrange their workspace freely and have an overview of the design stage as well as all the design resources. Nuggets were adjusted proportionally e.g. the touch area, font size, menu bar size etc. to match the large screen.

The interactive wall is divided into three areas to be used during different design phases, e.g. brainstorming on the left, sketching in the middle, and mockup design on the right. In between different design phases, MikiWiki could be refined according to emergent socio-technical issues. For instance, participants combined the drawing nugget with the sync-imagenote nugget, to draw on top of image notes. The drawing nugget was always automatically positioned in front of other nuggets to allow sketching; therefore participants could not interact with the nuggets that were behind the drawing nugget. The drawing nugget was modified in order to provide two different states: in the expand mode, one can sketch on the sketch board; in the toggle mode, one can interact directly on the mobile canvas, which is below the drawing nugget, for instance by dragging and dropping design icons on the mobile canvas. This should effectively enable participants to switch on and off the doodling mode, without having to reposition the drawing nugget.

Figure 4 Combing the drawing nugget with the panel nugget

5.2 Sandbox for Tinkering

Small tools allow all the stakeholders to play with, tinker and try use cases and the differentiation of cases in accordance with certain conditions. Using MikiWiki with an interactive large screen can be characterized as a ‘sandbox for tinkering’. In the words of [In02] “It was quite nice that we didn’t jump from tool to tool to do different things. Brainstorming feels more like a different tool, starting from a simple GUI. We just tried what we had there to achieve what we wanted. It really felt like a little playground, when you had many possibilities. [...]”

It is necessary to support participants in exploring solutions and “what-if” scenarios, trying out assumptions to assess requirements continuously.

For example, Figure 5 illustrates that two participants used various nuggets to externalize and document expectations. Referring to these externalizations on the large screen allowed participants to explain their requirements and design rationale, and to intertwine their perspectives and to foster synergy building. The visualized ideas were a continuous basis for refining and extending them from moment to moment. They also “borrowed” their brainstorming phase robots and statistical image notes directly into the final output phase. Nuggets were therefore used to intertwine their diverse perspectives as well as bridge different design phases.

Notably, two participants had different opinions about the “look and feel” of the barometer interface at the beginning, and they rapidly prototyped a robotic style and a “Hello Kitty” pink style (Figure 5) to express different emotions and feeling with respect to the characteristics of the system to be designed – and consequently to the requirements it will have to meet.

On the other hand MikiWiki facilitates participants to reach a common understanding by interacting with the concretely available tools and materials. To quote [In09] “It’s fast, you can directly show your ideas, and improve them. If I have an idea and I show it to another person, and then the other person could say, ‘Yeah this is good or bad, but I think it would be better...’ - the other person can directly show me what he means.”

Figure 5 Borrowing design elements from the brainstorming phase

It is important to support participants in creating and sharing design ideas via different means. Visibility is crucial in externalizing ideas, reasoning about ideas or discussing them. It also supports users in coming up with new ideas, since participants have the opportunity of listening and seeing other participants’ ideas and therefore being inspired by them.

5.3 Visual Comprehensibility

The combination of the interactive wall and MikiWiki supports the large picture – the visualization of rich material [8], which is important for enhancing collaborative creativity in this co-located situation.

[In03] “I think what was cool is that it has possibility to show you all three phases we had during the process. Ideas were still there, I think part of because we have a large screen. We had ideas on the left side, and kind of image browsing we did in the middle, and when we did our mockups, we still could look at weird [ideas from previous phases]... I could see there were lots of ideas.”

[In12] “It helped me a lot, because it was very ‘anschaulich’ [the German for ‘visually comprehensible’]. You have everything in front of you. I have an overview, and at the same time, that’s kind of structured and clear. You can be creative, because you have all these tools, you can draw, you can use the signs, you have colors...”

During the output phase of design session 5, participants used a mockup environment to finalize their application. They created an interface with five different color buttons, different colors indicating a scale of 1-5 points. However, during the review phase, one participant pointed out that the application style did not match their moodboard style, i.e. minimalism, modern
classic, limited color scheme. They eventually came up with silver glossary buttons with numbers on to indicate the scale.

5.4 Reciprocal Acceleration of Creativity

We observed that being together working on the same problem space within an interactive space has an effect of “reciprocal acceleration of creativity”

[In01] “The drawing nugget was very useful, because of that, seeing for example someone was developing and evolving ideas, just by looking at what he was doing on the wall. It was very inspiring to develop own ideas.”

[In06] “I was stuck with my old ideas, I couldn’t get away from it. It’s more about cognitive problems... Later on, the fact was that they [other participants] created different ideas, all different ideas of how the system could look like. This helped me look over the edge of my ideas, looked at problems from different perspectives...”

It accelerates the creative process if one can see the ideas of others or can anticipate them – as quick as possible. Consequently, perceived ideas lead to new ideas / results at the site of the observer and which in turn are observed by actors who can be further inspired. The point is that people can react to other ideas as long as they are still in a flow or at least in the context of the problem and solution space which is under discussion. In an asynchronous mode they will be concerned with another type of problem before they return to how others have reacted to their ideas.

5.5 Providing Seeds to Cope with Blank Space Syndrome

However, the drawbacks of such an environment can include sequential creation processes due to its single touch constraint or dominated participants.

[In05] “I think perhaps a group of four people might be too big for some phases. It’s like taking parts, one gave ideas and it took some time to bring them to the wall. Especially, you had your ideas, and you wanted to make them concrete, but one was acting and the other three were standing there...”

A blank canvas can be intimidating, as it lacks structure and its openness leaves most users at a loss about how to proceed. Indeed, it is much harder when one has to come up with something new from scratch. We observed that especially at the beginning participants were mostly talking rather than interacting with the wall. Therefore, their thoughts and discussion were not captured on the wall during this period. One of the side effects is that participants did not take responsibility for what they were saying, and tended to forget some of their suggestions. As without any trace on the wall, it was hard to track the genesis of ideas.

Moreover, since participants tended to forget their responsibilities and what they had discussed, leaving traces on the screen (such as using notes or colors to assign meaning and track individual responsibility) helped to minimize this issue.

Another issue is that the perceived big gap between those who work as designers and the “normal” users pushed the designer to take the lead in the design phases, while users were somehow more reluctant to express their ideas [In13]. In particular during the brainstorming phase, it was difficult for users to come up with design ideas and criteria. Although users were observing, listening to the ideas proposed by the designer and learning how to design at the same time, users generated fewer solutions and shared less of their own knowledge with the group.

In order to encourage participants to interact with the touch screen as well as record the entire design process, some initial examples were designed and adapted in-between design sessions, in the meta-design phase. For instance some colorful notes with design criteria for the mobile app, and a mood board to express the final application “look and feel.” These demonstration examples became seeds for the participants, not only inspiring them to other possibilities, but also showing how to use MikiWiki. Participants could take examples further by developing, refining and appropriating them.

6. CONCLUSIONS

In this paper we have leveraged a meta-design approach to explore interactive space. Since each interactive space is unique, software must be adapted to the available components.

Adaptation of software copies with changes that occur in both technological development and user requirements, e.g. reflecting upon the users’ needs for noting down and visualizing their ideas, supporting the user with a mode of reciprocal acceleration of creativity. Issues such as cold start and dominant participants caused creativity blocking, but can also be eased via providing seeds during the meta-design phase.

The next steps in this research include supporting multiple input devices, providing personal and public spaces and refining MikiWiki for different design contexts, focusing on creation process.

7. REFERENCES


